

5E Lesson Plan

Lesson Title:

The Greenhouse Effect

Subject area / course / grade level: The Earth/Grade 5

Introduction: Create a model to illustrate the 'Greenhouse Effect' and the amount of Sun's energy absorbed by different surface materials

Lesson Length:

Materials: 2-3 Shoeboxes, construction paper of different color, bowl, water, cellophane, thermometer

Lesson Overview:

This activity allows students to build a simple model of the Earth's surface and lower atmosphere to illustrate the Greenhouse Effect, and to examine how different surface materials absorb different amounts of solar radiation.

Tennessee Standards: Grade 6:

Standard 8 – The Atmosphere: a) Checks for Understanding: Design and experiment to investigate differences in the amount of Sun's energy absorbed by a variety of surface materials. b) Use data collected from instruments such as a thermometer to describe local weather conditions.

Lesson objective(s): To help understand the concept of the Greenhouse Effect, and how different Earth surface materials influence the temperature of the lower atmosphere.

ENGAGEMENT

Describe how the teacher will capture students' interest.

Some planning is required here. Ask the students to describe or make observations about how temperature is different on a non-stormy cloudy night vs. a clear night. Observations can be made by either students either directly recording the weather conditions over a several day period, or acquiring the information from the National Weather Service or weather.com. The following data should be recorded at the same time every night: time, temperature, sky conditions.

What kind of questions should the students ask themselves after the engagement?

Students should ask themselves why temperature would be different on a cloudy night, as opposed to a clear night.

EXPLORATION

Describe what hands-on/minds-on activities students will be doing.

Students will construct a model of the Earth's surface, with several variables which allow them to determine how different Earth atmospheric and surface materials affect the temperature of Earth's lower atmosphere.

List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration.

Where does the energy which warms Earth's lower atmosphere come from?

Does all of the Sun's energy coming into the atmosphere reach Earth's surface? If not, why?

What kinds of the Sun's energy reach Earth's surface?

What is the difference between absorption and emission?

How is energy absorbed by Earth's surface different than energy emitted by Earth's surface?

What are the two most abundant greenhouse gasses in Earth's atmosphere?

What happens when energy emitted by Earth's surface is absorbed by 'greenhouse gasses' in the atmosphere?

How does this affect the temperature of the Earth's lower atmosphere?

EXPLANATION

Student explanations should precede introduction of terms or explanations by the teacher. What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?

Students need to build their own model according to their own perceptions of Earth's surface. It is important for students to know that there is no 'right' or 'wrong' way to build their model, but they are expected to explain why they chose to include certain items (variables) in their model (i.e., what does each part of the model represent in terms of Earth materials.)

List higher order thinking questions which teachers will use to solicit *student* explanations and help them to justify their explanations.

Why did you, the student, choose to include this variable in your model. What Earth material does it represent?

ELABORATION

Describe how students will develop a more sophisticated understanding of the concept.

The model allows students to learn basic theory of the Greenhouse Effect, but also how differences in Earth's surface features can modify the effect. The exercise allows students to explore how incorporating variables into a model can change the outcome.

What vocabulary will be introduced and how will it connect to students' observations?

See attached.

How is this knowledge applied in our daily lives?

Students should discuss how changes in Earth temperature affect their daily behavior (clothing, outdoor activities, etc.).

EVALUATION

How will students demonstrate that they have achieved the lesson objective?

Students should keep a written record of how they have constructed their model, and the rationale behind the materials they choose.

Students will keep a record of temperature data for each experiment they run.

Students will write a conclusion as to which earth materials have the greatest effect on lower atmosphere temperatures.

Note: Students will ask why one Earth material has a greater effect on atmospheric materials than another.

This should be embedded throughout the lesson as well as at the end of the lesson

Important: Background Information for this exercise is at:

<http://mtweb.mtsu.edu/cribb/1030Atmosphere.ppt>

<http://mtweb.mtsu.edu/cribb/1030Atmosphere.html>

The Greenhouse Effect

Brief Description: This activity allows students to build a working model with variables to study the Greenhouse Effect, and how different Earth surface materials affect lower atmospheric temperatures:

Materials Needed: Shoe-box, cellophane, construction paper, bowl, rocks, water, thermometer (digital outdoor thermometer works best.).

Expected Outcomes: 1) Understanding of why the Greenhouse Effect naturally occurs. 2) Understanding of why the Greenhouse Effect is not the same at every location. 3) Understanding of how to build a scientific model with variables.

Teacher Background: See attached.

Model Construction:

- 1) Cut/remove the top from a large shoebox.
- 2) Cut to size and glue construction paper to the bottom and sides of the shoebox. Choose the color of the paper to reflect a specific Earth surface (green = grass, brown = desert, etc.). Add items of your choice to complete the environment (animals, plants, buildings, etc.)
- 3) Cut a small hole in the end of the shoebox (for thermometer or temperature probe)

Data Collection:

- 1) Place the model in direct sunlight. Measure and record the temperature inside the box.
- 2) Cover the box with clear plastic wrap. The seal between the plastic wrap and the box edges should be as tight as possible.
- 3) Insert the thermometer/probe. Measure and record the temperature every 30 seconds for 5 minutes. If the temperature continues to change after 5 minutes, continue to record every 30 seconds until the temperature has stabilized.
- 4) Remove the plastic wrap. Cover the bottom of the box with dark rocks. Repeat the experiment.
- 5) Remove the plastic wrap. Cover the bottom of the box with light rocks. Repeat the experiment.
- 6) Remove the plastic wrap. Cover the bottom of the box with sand. Repeat the experiment.
- 7) Remove the plastic wrap. Place a cereal bowl filled with water in the box. Repeat the experiment.

Surface Material: _____

Temperature Uncovered: _____

Time	Temperature	Time	Temperature
0.5 min		6.0 min	
1.5 min		6.5 min	
2.0 min		7.0 min	
2.5 min		7.5 min	
3.0 min		8.0 min	
3.5 min		8.5 min	
4.0 min		9.0 min	
4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material: _____

Temperature Uncovered: _____

Time	Temperature	Time	Temperature
0.5 min		6.0 min	
1.5 min		6.5 min	
2.0 min		7.0 min	
2.5 min		7.5 min	
3.0 min		8.0 min	
3.5 min		8.5 min	
4.0 min		9.0 min	
4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material: _____

Temperature Uncovered: _____

Time	Temperature	Time	Temperature
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2.5 min		7.5 min	
3.0 min		8.0 min	
3.5 min		8.5 min	
4.0 min		9.0 min	
4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material: _____

Temperature Uncovered: _____

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2.5 min		7.5 min	
3.0 min		8.0 min	
3.5 min		8.5 min	
4.0 min		9.0 min	
4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material: _____

Temperature Uncovered: _____

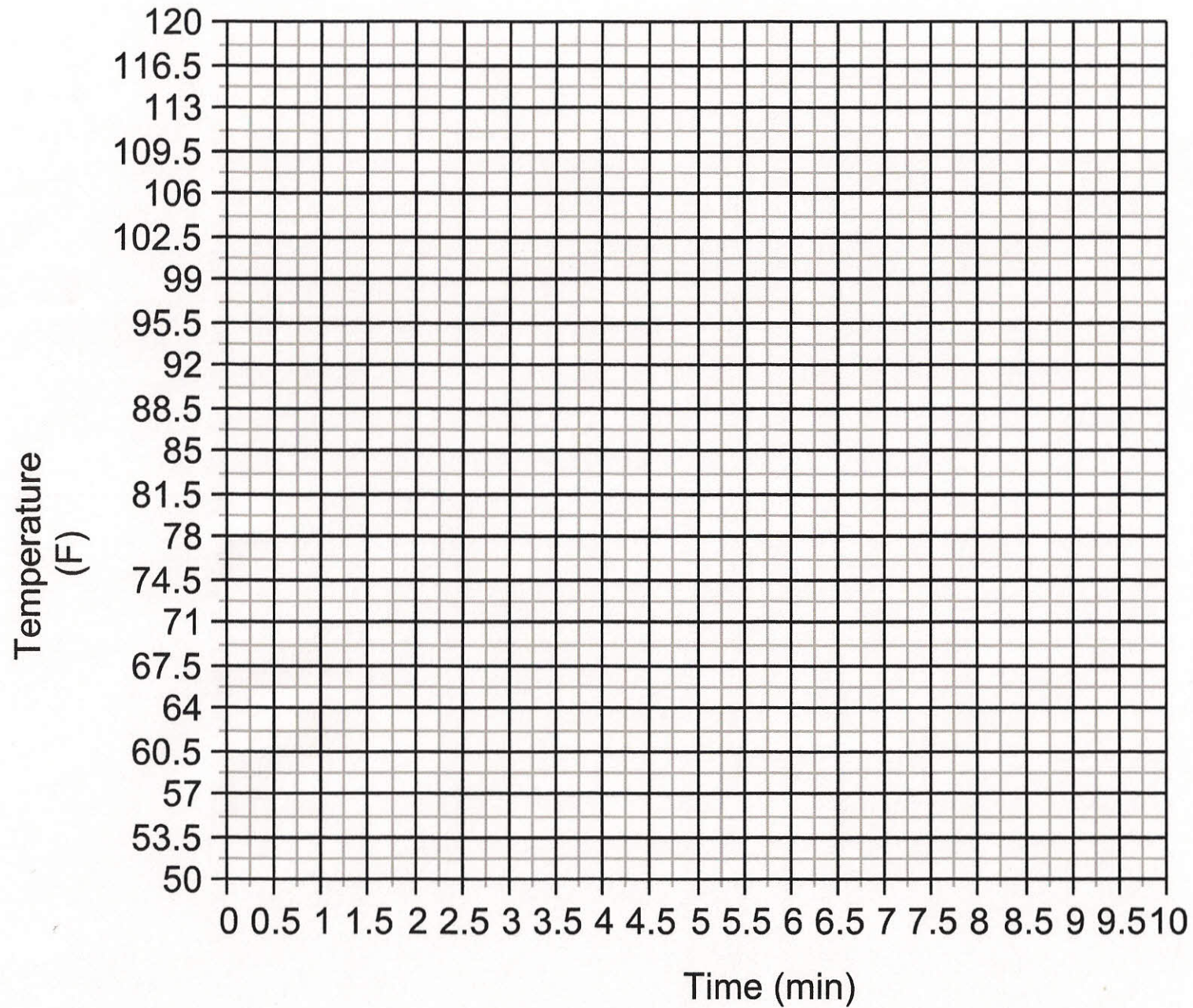
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4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material: _____

Temperature Uncovered: _____

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2.5 min		7.5 min	
3.0 min		8.0 min	
3.5 min		8.5 min	
4.0 min		9.0 min	
4.5 min		9.5 min	
5.0 min		10.0 min	
5.5 min		10.5 min	

Surface Material:



Name:

Which surface material results in the highest temperature?

Which surface material results in the lowest temperature?

What is an explanation for the difference?

Which surface material causes temperatures to increase the fastest?

Which surface material causes temperatures to increase the slowest?

What is an explanation for the difference?

Compare the results of your model experiments to the place you live and answer the following questions:

Where would you expect temperatures to be highest? Why?

Where would you expect temperatures to be lowest? Why?